Letters to the Editor.

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The Structure of the Red Lithium Line.

IN a recent number of the Proceedings of the Royal Society Prof. McLennan and Mr. Ainslie have announced the interesting discovery of a new component of the line $\lambda = 6708$ in the spectrum of lithium, the line appearing, under the conditions of excitation employed by them, as a quartet. They proceed to discuss the possibility of this structure being due to two pairs of lines, each pair being assigned to one of the isotopes of lithium. To the present writer it appears that the new components cannot be accounted for in this manner.

The structure of the line in question has been investigated by Kent (*Astrophys. Journ.* vol. 40, p. 337, 1914), Takamine and Yamada (Proc. Tokio Math. Phys. Soc., vol. 7, No. 18, p. 339, 1914), Zeeman (Proc. Roy. Acad. Amsterdam, p. 1130, Feb. 1913; p. 155, Sept. 1913), King (*Astrophys. Journ.*, vol. 44, p. 169, 1916), and the writer (Proc. Roy. Soc. A, vol. 99, p. 101, 1921). Kent, and Takamine and Yamada, observed it as a single pair of emission lines, and Zeeman, who investigated the absorption spectrum, also recorded a single pair of lines, with the reservation that with a high density of the absorbing vapour other lines made their appearance. Zeeman considered that these lines which appeared at high vapour densities were analogous to lines observed in the sodium spectrum by R. W. Wood. King, who investigated the structure of the line in the arc and in the tube-furnace, found that with a low vapour density the line appeared as a simple pair, and that at higher vapour densities a third component appeared; with a still greater amount of vapour the phenomena were complicated by reversal. King has published one photograph in which, owing to reversal, the line has the appearance of a quartet. McLennan and Ainslie used a vacuum arc under conditions in which it would appear that the density of the lithium vapour must have been very great, and one may surmise that this condition is essential for the appearance of the fourth component.

It seems, however, that under appropriate conditions the line appears as a simple pair, and our ideas as to the nature of isotopes would have to be profoundly modified if the pairs due to the two isotopes were found to require different conditions for their excitation. If the four components were really two pairs due to the two isotopes they should always appear together with an invariable intensity ratio of 1 : 16. The line can be seen easily as a simple pair in a carbon arc in air if the poles are brushed over with an exceedingly dilute solution of a lithium salt. The components are then less sharp than when the vacuum arc is used, and the main difficulty is to have little enough lithium in the arc, so as to avoid the appearance of the third component and complex structures due to reversal. In the vacuum arc the third component appears very readily unless the amount of lithium vapour is small. It may further be mentioned that the relative intensities of the components are not in good accordance with the view that they are due to the two isotopes.

From a theoretical point of view also, there are grave difficulties. The calculated separation, on Bohr's theory, of corresponding lines in the pair, is about 0.087Å., the observed separation being between three and four times as great. McLennan and Ainslie put forward the suggestion that the separation may in fact be the product of the "calculated separation" and the atomic number; but the correctness of the calculated separation has been verified by the observed differences between the lines of the Balmer series of hydrogen and alternate members of the ζ Puppis series of helium, and in this case the agreement is exact and the "calculated separation" does not require to be multiplied by a factor of 2, the atomic number of helium.

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The Mechanism of the Cochlea.

IN view of the discussion in these columns towards the end of 1918, and the letters which followed it at various times, the model designed by Mr. George Wilkinson, of Sheffield, and described in NATURE of October 21, p. 559, is of much interest and importance. It is obvious that the construction of such a model presented many mechanical difficulties, and great credit is due to Mr. C. E. Stewart, the mechanician of Prof. Leathes's laboratory, for the successful result. It may, therefore, be useful to mention that a full description was published in the *Journal of Laryngology and Otology*, of September last, a short account having been given in the Proceedings of the Physiological Society (*Journal of Physiology*, vol. 56, p. ii). The apparatus was demonstrated to the Physiological Society in December 1921, as also to the British Association in September 1922.

I take it that others besides medical students have been dissatisfied with most of the theories put forward to avoid the difficulties thought to be involved in the Helmholtz view of the resonance of the basilar membrane. Those theories in which this membrane is supposed to act as a whole, like a telephone diaphragm, or by "pressure patterns," are inconsistent with the progressive differentiation of structure along the membrane, in addition to being in conflict with what is known of the conducting properties of nerve fibres. Thus the views suggested by Ewald, Rutherford, Waller, and Wrightson are unacceptable. It appears that although Helmholtz had referred incidentally to "loading" of the vibrating elements of the membrane by the liquid in which it lies, the great importance of this factor was first realised by Mr. Wilkinson and investigated experimentally by him. His model is doubtless capable of still further improvement, but even in its present form many problems would have light thrown upon them by its behaviour. The degree of damping and the spread of resonance to neighbouring elements may be mentioned. The number of waves required to excite sympathetic resonance of a tuned element may perhaps be determined. Some degree of spread is not inconsistent with the Helmholtz theory, since the amplitude of vibration of other elements than those in tune with the vibrations received might well be too small to stimulate the nerve endings. Dr. Gray has shown that a similar cutting out of small stimuli takes place in the localisation of a point of pressure in the skin.

It is of interest to note that the model responds to a tuning-fork held in contact with the brass case, just as the cochlea does to conduction through bone. This indicates that the impulses given by the movements of the stapes are the same as those of sound waves directly transmitted through water, as would be expected from theoretical considerations.